



京都大学  
KYOTO UNIVERSITY

14th March 2024

## Torishima and Kyoto University Make Hydrogen History with World's First High-Flow, High-Efficiency Liquid Hydrogen Pump

In a pioneering leap forward for hydrogen technology, Torishima Pump Mfg. Co., Ltd. (Torishima) and Program-specific Professor Taketsune Nakamura from the Graduate School of Engineering at Kyoto University have jointly developed the world's first liquid hydrogen pump that marries high-flow capacity with unparalleled efficiency. This innovation, powered by a superconducting motor, marks a crucial advance towards a sustainable hydrogen economy.

### 1. The Drive for Carbon Neutrality

At the heart of global efforts to achieve carbon neutrality lies the imperative to harness clean energy sources like hydrogen. However, the widespread adoption of hydrogen as a fuel has been constrained by the cost challenges associated with its production and transport. Torishima, a firm with a mission to "Save the world with pumps," embarked on this groundbreaking project alongside Kyoto University in 2021. The project gained momentum in 2023 with support from a Japanese governmental agency, NEDO\*1 grant "Development of Technologies for Building Competitive Hydrogen Supply Chain".

### 2. Innovative Features of the Development

The collaboration has yielded several key innovations:

#### 1) High-Speed Rotation Technology:

Building on Torishima's expertise in developing high-temperature, high-pressure multistage pumps, the team achieved a breakthrough with a pump that operates at a high-speed rotation of 5,000 min<sup>-1</sup>, essential for pressurizing and transporting low-density liquid hydrogen.

#### 2) Superconducting Motor:

By employing a superconducting motor, developed under the guidance of Program-specific Professor Taketsune Nakamura, the pump set drastically reduces heat generation. Superconducting motor operates at very high efficiency without heat generation. This innovative approach prevents the gasification of liquid hydrogen, ensuring efficient transport.

### 3) A Fusion of Expertise:

The project represents a milestone in technological collaboration, combining Torishima's deep knowledge in pump technology with Kyoto University's pioneering research in superconducting motors, to create a pump that can efficiently transfer large volumes of liquid hydrogen.

### 3. Operational Test Success

Operational tests conducted on March 6th and 7th at JAXA's<sup>\*2</sup> Noshiro Rocket Testing Center in Akita Prefecture confirmed the pump's performance, achieving the world's highest flow rate and pressure for a liquid hydrogen centrifugal pump. These results are a testament to the pump's innovative design, marking a significant breakthrough in technological and cost challenges. The main achieved specifications are as follows;

Flow rate : 30.5 m<sup>3</sup>/hr

Pressure : 1.6 MPa

Speed : 5,000 min<sup>-1</sup>



### 4. Looking to the Future

The successful development of this high-flow, high-efficiency liquid hydrogen pump, supported by NEDO, sets the stage for the commercial viability of hydrogen supply chains beyond 2030. The pump is expected to play a critical role in the hydrogen economy and will make a significant contribution to achieving the Japanese Government hydrogen supply cost target of 20 yen/Nm<sup>3</sup>.

Further details about this revolutionary development will be unveiled in an upcoming press conference, with more information to be shared with members of the press.

\*1 NEDO : New Energy and Industrial Technology Development Organization

\*2 JAXA : Japan Aerospace Exploration Agency

### **【Torishima Pump Mfg. Co., Ltd.】**

Founded in 1919, Torishima Pump Mfg. Co., Ltd. has established itself as a leader in the pump manufacturing industry, specializing in large-scale, high-pressure pumps for water treatment, power generation, and desalination plants, and serving customers in over 100 countries. The company is committed to contributing to a safe and energy-efficient society and strives to be an indispensable part of the global community.

Headquarters : 1-1-8 Miyada, Takatsuki-city, Osaka, Japan  
Stock listed markets : Prime market of the Tokyo Stock Exchange  
Website : <https://www.torishima.co.jp/en/>

### **【Program-specific Professor Taketsune Nakamura, Graduate School of Engineering, Kyoto University】**

1998	Ph.D. degree from the Department of Electrical and Electronic Systems Engineering, Graduate School of Systems Information Science, Kyushu University, Japan.
1998 - 2005	Assistant Professor with the Department of Electrical Engineering, Graduate School of Engineering, Kyoto University, Japan
2005 - 2017	Associate Professor with the same affiliation
2017 - present	Program-specific Professor with the same affiliation
2019 - present	Visiting Researcher with the Research Institute of Applied Sciences, Japan
2020 -present	Part-time Visiting Professor with the Department of Mechanical and Electrical Systems Engineering, Faculty of Engineering, Kyoto University of Advanced Science, Japan

His research interests include first-principle research on electrical-mechanical energy conversion, basic research on normal conducting and superconducting rotating machines, and research and development on applications for in-vehicle and other systems.

Member of the Institute of Electrical Engineers of Japan, the IEEE, the Cryogenics and Superconductivity Society of Japan, the Japan Society of Applied Physics, and the Society of Automotive Engineers of Japan.